NON-PUBLIC?: N
ACCESSION #: 9304020293
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Dresden Nuclear Power Station, Unit 3 PAGE: 1 OF 7

DOCKET NUMBER: 05000249

TITLE: Reactor Scram on High Reactor Pressure Caused by Blockage
of the High-Pressure Section of the Main Turbine
EVENT DATE: 02/26/93 LER #: 93-007-00 REPORT DATE: 03/25/93

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 099

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Michelle Fendrich - Tech Staff TELEPHONE: (815) 942-2920
Thermal Engineer Ext. 3533

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: TA COMPONENT: TRB MANUFACTURER: G080
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On February 26, 1993, at 16:17 hours with Unit 3 operating at a steady thermal power of 99.4%, an automatic reactor scram occurred due to high reactor pressure. Review of plant data indicated that the high reactor pressure was caused by a flow blockage in the high pressure turbine. Disassembly revealed that foreign objects had entered in the first stage of the high-pressure turbine. One of the objects, or debris from internal damage, came in contact with the rotating assembly and caused damage which restricted steam flow. The safety systems functioned as designed during the subsequent scram recovery. Damage to the first-stage diaphragm and rotor will be repaired. The Foreign Material Exclusion (FME) program will be enhanced to prevent further events of this nature. A history search revealed there were no similar events of objects entering the turbine and causing damage at Dresden.

END OF ABSTRACT

PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor -2527 MWt rated core thermal power.

Nuclear Tracking System (NTS) tracking code numbers are identified in the text as (XXX-XXX-XX-XXXXX).

EVENT IDENTIFICATION:

Reactor scram on reactor high pressure caused by blockage of the high pressure section of the Main Turbine TA!.

A. CONDITIONS PRIOR TO EVENT:

Unit: 3 Event Date: February 26, 1993 Event Time: 1617

Reactor Mode: N Mode Name: Run Power Level: 99.4%

Reactor Coolant System (RCS) Pressure: 1020 psig

B. DESCRIPTION OF EVENT:

At approximately 15:55 hours on February 26, 1993, while Unit 3 was operating at 99.4% thermal power, the High-Pressure (HP) Turbine Differential Expansion Detector (DXD) indicated an axial shift of approximately 8 mils toward the generator end 23 minutes prior to the scram. At the same time, the thrust bearing front plate temperature began to slowly increase from 142 degrees F. The turbine 1st Stage High Pressure alarm began alarming intermittently approximately fifteen minutes later with pressures of 900 to 901 psig. In response to this alarm, the Unit 3 Nuclear Station Operator (NSO) reduced load 4 MWe to 815 MWe. At 16:17:14 hours, the 1st Stage High Pressure alarm was received again at 908 psig and the Control Valves (CV) opened to 100% position from 75% position. The #1 Bypass Valve opened 6 seconds later to compensate for high pressure. The Max Combined Flow Limit alarm came up with the turbine bearing thrust front plate temperature increasing by 6 degrees F. Turbine bearings 1, 2, and 3 vibration recordings showed spikes of approximately 1 mil. A step drop in generator output to

785 MWe occurred while reactor pressure began to rise with a corresponding thermal power increase as indicated by the nuclear instrumentation. As the HP bowl pressure increased, reactor pressure increased and both the HP exhaust pressure and low-pressure (LP) turbine inlet pressure decreased. At 16:17:36 hours an automatic reactor scram occurred on high reactor pressure (1060 psig). The backlit red first-out annunciator was Source Range Monitor (SRM) IL! Hi-Hi, and not Reactor Pressure Hi-Hi as expected. Primary Containment Group II and III Isolation Valve closures occurred on low reactor water level (+8"). Reactor Building Ventilation isolated and the A train of Stand By Gas Treatment (SBGT) BH! auto started as designed. The reactor mode switch was placed in shutdown per Dresden General Procedure (DGP) 02-03, (Unit 2/3 Reactor Scram). One minute after the reactor scram, the generator tripped on reverse power, which caused the Unit 3 turbine to trip. Millwrights on the turbine floor heard a grinding noise just prior to the trip that disappeared immediately following the turbine trip. Operators restored reactor Building Ventilation to normal at approximately 16:28 hours. Normal scram recovery continued after this point with the Unit 3 Main Turbine approaching turning gear operation with no abnormal vibration seen on the roll down.

Approximately 1 minute after the reactor scram, the X-Area Cooler Blowers 3A through 3F spuriously tripped, apparently due to overcurrent. A member of the Operating Department reset the main feed breaker at MCC 38-2 and attempted to reclose the breaker. The breaker tripped again. The operator opened the individual motor feed breakers, closed in the main feed breaker, and then closed the individual motor breakers. The main feed breaker did not trip.

During the scram, the 3-5401A and 3-5401B Steam Jet Air Ejector (SJAE) WF! valves closed Spuriously. The valves were manually opened by the Unit 3 NSO at 16:38 hours.

After a review of the scram data and identification of the discrepancy between HP Turbine inlet and outlet pressure, the turbine was walked down by a General Electric (GE) representative and System Engineer while the Unit 3 Main Turbine was on turning gear. A slight clank and rubbing sound was thought to have been heard in the HP section of the turbine. On Monday, March 1, 1993, the turbine valves were cycled and proper stroke was verified.

The scram investigation team was assembled in accordance with the Dresden Administrative Procedure (DAP) 7-15. The following problems were identified and are discussed in this report:

1. Reactor scram due to HP turbine flow blockage.
2. SRM Hi-Hi first-out annunciator.
3. X-area cooler trip.
4. Two SJAE valves going closed.

C. APPARENT CAUSE OF EVENT:

This report is being submitted in accordance with 10CFR50.73(a)(2)(iv), which states that any event that results in manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS), must be reported. As stated previously, the reactor scram was caused by high reactor pressure as a result of flow blockage in the HP turbine.

1. Reactor Scram Due to HP Turbine Flow Blockage:

The shell casing on the HP turbine was removed to investigate the possibility of internal turbine damage causing steam flow blockage at 05:30 hours on March 5, 1993. Three foreign objects were discovered inside the turbine. The objects included a 8-3/4 inch long bolt, a slugger wrench, and a piece of keystock. The bolt is consistent with a part used on a control valve, although it is not physically possible due to the valve's configuration for the bolt to come out of a control valve and enter the pathway to the turbine. The wrench and keystock are consistent with the tools required to remove and install the bolt in the valve. It is possible that the objects may have entered into a steam line through an opening from a disassembled control valve as a result of planned maintenance in late 1991 or entered directly into the open HP turbine casing during maintenance in early 1990. However, the actual circumstances for the introduction of these objects could not be determined.

High Pressure Turbine overhaul work was performed from 12/3/89

to 2/10/90, Dresden Maintenance Procedure (DMP) 040-38, "barrier installation and cleanliness inspection checklist" was used as a programmatic foreign material exclusion barrier during this work. One possible way the foreign material entered the turbine was during maintenance on the high pressure section. In this scenario, when the HP turbine casing is open, numerous maintenance activities are taking place in and around the turbine casing. Due to this condition, plausible opportunities exist for foreign material to enter the turbine casing through work above the casing or from adjacent control valve lay down area work.

A second scenario can then be postulated for introduction of the foreign objects into the Main Steam line. Turbine associated valve overhaul work was performed on the #3 Control Valve and #4 Main Stop Valves from 9/8/91 to 3/22/92. During this work the Turbine Control valves are removed from their installed position to a remote area where the maintenance is performed. The Control valve bolts which are the same as that found inside the turbine and contributed to the damage are removed and replaced. This scenario is less probable than the previous one as the tools and spare parts used during the maintenance are used in an area which is remote from the actual valve installation location.

Preliminary Engineering calculations have been performed to verify steam in the main steamline is capable of lifting and transporting the three objects through the main steamlines and into the turbine. The objects apparently came to rest in the generator-end diaphragm. After an unknown period of time, debris from damage caused by the foreign material became wedged between the rotating assembly and the stationary partitions of the first stage diaphragm. The first stage blading was sufficiently deformed to partially close the steam path and lead to the high reactor pressure.

The root cause of this incident is a FME program that was not wide enough in scope to preclude the material's introduction potentially from locations remote to the turbine proper. It was not possible to determine if the objects entered through the open Control Valves or the open turbine. Individuals who participated in previous turbine maintenance activities were interviewed and no evidence was obtained to support that it was an intentional act.

2. SRM HI-HI First Out Annunciator:

The CHANNEL A/B SRM HI-HI alarm is set to annunciate if the SRM detects more than 4.8E5 counts per second. The alarm appeared on the Sequence of Events Recorder (SER) approximately 30 seconds after the scram. The SER filters spurious alarms by requiring a continuous 100 millisecond signal prior to annunciation. The Control Room panel alarm does not require this time delay and, therefore, it is believed that a spurious signal caused the annunciator to activate. The spurious signal is still being investigated (NTS 249-180-93-00702).

3. X-Area Cooler Trip: The apparent cause of the initial tripping event is currently unknown. A review of maintenance history for this breaker indicated that this breaker previously experienced a spurious trip. On June 6, 1991, under Nuclear Work Request (NWR) D01869 the X-Area Cooler feed breaker was noted to trip. The breaker was immediately reset. Amperage checks of local cooler breakers and the main feed were satisfactory. However, the breaker tripped again when the door was opened. The breaker was exchanged with a spare breaker. A supplemental note made on July 11, 1991, indicated that the breaker was found buzzing and smoking, and that the 'A' phase was low on the load side of the breaker. Under NWR D01978, the original breaker and cubicle were refurbished. The refurbished circuit breaker was successfully tested and reinstalled into its original cubicle.

The second trip which occurred when the operator attempted to close the main feed breaker is attributed to the inrush current that resulted from starting all six cooler fans simultaneously.

4. Two SJAE Valves Going Closed:

The initial causal factor identified in the Unit 3 NSO Log attributed the valve closures to instrument bus automatic power transfer. This was initially considered feasible because the instrument bus powers relay 595-145 which would result in valve closure if deenergized. If the 595-145 relay did, in fact, cause the valve closures, the Group I isolation logic would have to be reset. There is no record of this action in the Unit 3 NSO Log or in the documented investigation interviews.

The most probable cause of this event appears to be a low value for the 3B booster air ejector steam pressure. Per the SER, the 3B SJAE STEAM PRESS LO alarm came active, the valves subsequently closed, the alarm cleared, and the valves were reopened by manual operation of the control switches. This sequence of events is consistent with the documented interlock logic for the valves per print 12E3489.

D. SAFETY ANALYSIS OF EVENT:

1. Reactor Scram Due to HP Turbine Flow Blockage:

The safety significance of the reactor scram is considered to be minimal because all ESF operated as designed. The turbine controls worked as designed; the CVs opened to attempt to maintain reactor pressure, and the bypass valves opened up to the maximum combined flow limit. The Main Turbine tripped and came to turning gear operation with no abnormal events.

2. X-Area Cooler Trip:

The purpose of the X-Area Room Cooler Blowers is to maintain the temperature of the X-Area below 200 deg F which corresponds to the Technical Specification Table 3.2.1 trip setpoint limit for the main steamline tunnel high-temperature switches. Elevated temperatures in this area are generally indicative of a main steamline break which would result in Group I isolation. The cooler does not perform a safety-related function. The failure of the coolers would have no affect on the ability of the X-Area temperature switches to accomplish their safety function of providing a Group I isolation on high temperature or steamline break.

3. Two SJAE Valves Going Closed:

The SJAE valve closure resulted in minimal safety significance. The valves operated as designed by failing in a conservative position.

E. CORRECTIVE ACTION:

1. Reactor Scram Due to HP Turbine Flow Blockage:

The internals of the HP turbine will be repaired or replaced as necessary. The first-stage generator-end diaphragm inlet nozzles will be repaired on site. General Electric will supply buckets to replace the first-stage generator-end buckets on the rotor. The turbine will be low-speed balanced before being placed back in service. A camera will be used to inspect the main steamline leads to verify no foreign material is present prior to reactor startup (NTS 249-180-93-00701). The FME station procedures will be revised to include specific requirements during main turbine and auxiliary work (NTS 249-180-93-00702).

2. SRM HI-HI First-Out Annunciator:

The Instrument Maintenance Department will verify as part of the surveillance requirements for the Unit 3 startup that the SRM HI-HI setpoints are set properly (NTS 249-180-93-00703). The Nuclear Engineering Department (NED) tested the Control Room 903-5 panel indication on March 18, 1993, and found it to function as designed.

3. X-Area Cooler Trip:

The event was investigated under NWR D16486. The breaker was replaced with a new breaker. The original breaker will be tested to determine whether setpoint drift had occurred, or if the breaker was exhibiting failure. The cooler blower motors will be meggered to determine if motor grounding may have attributed to the spurious trip (NTS 249-180-93-00704).

4. Two SJAE Valves Going Closed:

The control scheme for the steam supply regulator is being investigated under NWR D09035 (NTS 249-180-93-00705). Work Request D17062 has been written to tune pressure controller PC 3-3041-22B (NTS 249-180-93-00706) and NWR D17061 was issued to calibrate pressure switch PSL 3-3041-21B (NTS 249-180-00707).

F. PREVIOUS OCCURRENCES:

A history search revealed corporate assessment of first-line maintenance supervision during June, 1990, observed satisfactory performance of the FME program at Dresden Station. The corporate assessment was held after an incident occurred on February 6, 1990, in which a torque wrench was lost in the Unit 3 hotwell. The FME

program at Dres
en Station was upgraded in 1992, including
development of a procedure to incorporate all key elements of a FME program and personnel training.

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Additional events were found involving FME practices on the Refuel Floor. Deviation Report (DVR) 12-2-89-085 was filed when Unit 2 Control Rod Drive (CRD) AA! B-11 would not withdraw past position 47 due to an SRM plunger wedged in the CRD guide tube on June 3, 1989. Dresden Administrative Procedure (DAP) 14-06, Fuel Integrity Monitoring Plan, was revised to address the impact of foreign objects in the reactor core. An additional event occurred on January 21, 1993, in which a safety clip from an air hose fell into the Unit 3 reactor cavity. The object was located and removed from the cavity.

G. COMPONENT FAILURE:

Manufacturer Nomenclature Mfg. Part Number

General Electric Co. Turbine, 6-Stage, 17OX326
Full-Arc Admission

A search of the Nuclear Plant Reliability Data system (NPRDS) revealed that Cooper Nuclear Station experienced a similar failure. On July 1, 1991, the Low-Pressure Turbine (Westinghouse Electric Corporation) was inspected as part of a five-year maintenance plan and damage was noted on the last row blades. The damage was a direct result of foreign objects in the turbine. The rotor was replaced.

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Commonwealth Edison
Dresden Nuclear Power Station
R.R. #1
Morris, illinois 60450
Telephone 815/942-2920

March 24, 1993

CWS PMLTR 93-0126

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Licensee Event Report 93-007, Docket 050249 is being submitted as required by Technical Specification 6.6, NUREG 1022 and 10CFR 50.73 (a) (1) & 10CFR 50.73 (a) (2) (iv).

Charles W. Schroeder
Station Manager
Dresden Station

CWS/slb

Enclosure

cc: A. Bert Davis, Regional Administrator, Region III
NRC Resident Inspector's Office
File/NRC
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